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WORKSHOP EXAMINES POSSIBLE SPACE MISSIONS FOR THE NEXT 25 YEARS

An orbiting space factory, a self-directed deep-space exploration robot, a fully automated Earth resources and environment monitor and even a lunar base that could grow through self-replication of many of its elements have been examined in a space technology assessment workshop, looking at the next 25 years.

Robotics, artificial intelligence, automation and remotely operated systems are vital to the future of these missions. The enormous benefits of such capabilities at affordable cost has prompted this joint NASA/American Society of Engineering Education summer study at the University of Santa Clara in California.

The 10-week workshop will be completed on Friday, Aug. 29, when an oral report will be presented at the University and reports are submitted for publication.

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The program participants include 18 professors of engineering mathematics and sciences, some 15 NASA engineers and scientists, and a number from interested industrial organizations. The group is drawing on the work of research institutions such as Stanford University, Calif.; Massachusetts Institute of Technology, Cambridge; and Stanford Research Institute in developing computer-based "intelligence" capability.

The workshop was structured to select and define a set of exciting and challenging space missions that would identify critical technology needs for future research and development. As such they are representative of possible future missions rather than specific proposals.

Feasibility analysis has concentrated primarily on four areas:

• A highly versatile "intelligent" satellite information system for most types of Earth survey. Previous systems have suffered from the fact that they record everything they "see," producing huge masses of data.

The proposed information system would do substantial amounts of selection and interpretation of the data coming from its sensors to provide results tailored to the specific needs of the requestor.

In one approach, the system would possess its own world model, stored in a 10-trillion-bit data memory. This would provide reference knowledge of the region of the requested observation.

The satellite would report exceptions to this reference model, such as changes in crop conditions, discarding such well-known phenomena as icebergs, lakes and other landmarks. This would result in a major reduction in the amount of data that must be transmitted and analyzed. The world model would be updated to reflect latest dynamic conditions.

• A second concept is a Deep Space Exploration system to provide reconnaissance, exploration and intensive surface study of planetary bodies.

Specifically, the group is looking at a mission to Saturn's planet-sized satellite, Titan. (Titan has an atmosphere and is bigger than the planet Mercury.) The proposed, self-directed system or robot would combine the functions of several, previously separate missions -- orbiter, atmospheric probe and mobile surface-exploration vehicle.

The vehicle would observe such a relatively unknown environment, and modify its "knowledge" and exploration techniques, based on what it had observed. Major improvements in remote sensors, as well as advanced computer intelligence, are required to select regions for more intensive investigations.

Such self-directed systems could be used to explore distant bodies within the solar system, the outer planets and their satellites, comets and asteroids. It is also the type of system required for the eventual exploration of planetary systems of other stars, where flight and communication times of years, preclude manned involvement and interaction.

• A third area is a facility for use of non-terrestrial materials -- from asteroids and moons of Earth and other planets. This would be a permanent, automated Earth-orbiting facility initially using the space environment for unique processing of Earth-supplied raw materials. It would progressively make greater use of non-terrestrial materials. The group is identifying processing and manufacturing techniques well adapted to the space environment. Basic starter facilities are being identified, to be capable of producing a wide range of products and other tools to expand the facility capability.

• Finally, the workshop defined, as an ultimate challenge for advanced automation, a factory on the Moon which would use lunar materials and could replicate itself. One of its first products would be another lunar factory, or factory segment. Such an automated, reprogrammable, self-replicating factory has been of theoretical interest for a number of years, as a way of rapidly expandng utilization of space resources. The workshop has developed proof-of-concept designs and surveyed the types of logical organization for such a factory, and the requirements for an Earth-based demonstration of the concept.

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